

OCTOBER 15, 1918

PRICE 25 CENTS

also place a one-cent stamp on this notice, mail the magazine and it will be placed in the hands of our soldiers or sailors destined to proceed overseas. No wrapping—no address.

OK Penny AVIATION AND AERONAUTICAL ENGINEERING



Spad Pursuit Airplane
French Official Photo

VOLUME V
Number 6

SPECIAL FEATURES
THE 300 HP. MAYBACH ENGINE
THE SOPWITH-CLERGET, "CAMEL"
AIRCRAFT BOLTS, SCREWS AND NUTS
SOME NEW ENEMY AIRPLANES
BRITISH ADVISORY COMMITTEE REPORT

Two
Dollars
a Year

PUBLISHED SEMI-MONTHLY
BY
THE GARDNER-MOFFAT CO., Inc.
120 WEST 32nd ST., NEW YORK

Entered as second-class matter, August 3, 1916, at the
Post Office at New York, N. Y., under act of March 3, 1879





A black and white advertisement for airplane manufacturers. It features several illustrations of early 20th-century aircraft, including biplanes and monoplanes, some with numbers like '30', '25', and '151' on their fuselages. In the lower left, there are silhouettes of four people standing. At the bottom center, there is a small circular logo with the letters 'Y.M.C.A.' and a cross. Below the logo, the text 'AIRPLANE MANUFACTURERS' is printed in a bold, sans-serif font.



A large advertisement for the Hall-Scott Motor Car Co. The top half features a large, stylized '1918' in a light, outlined font. Below it, on the right, is a detailed illustration of a Hall-Scott Type L-6 Airplane Engine. To the left of the engine, the years '1917', '1916', and '1915' are stacked vertically in a similar outlined font. Below the engine illustration, there is a block of text describing the engine's features and a list of specifications. At the bottom of the advertisement, the year '1908' is written in a large, bold font, and below that, the company name 'HALL-SCOTT' is written in a very large, stylized font with a small engine illustration integrated into the letter 'A'.

1918

1917

1916

1915

1908

HALL-SCOTT

INTO the Hall-Scott Type L-6 Airplane Engine is concentrated the result of ten years' airplane building experience. This engine embodies the superior points of the well known type A-5 and A-5a models, and in addition the latest features in airplane engine practice.

| | | |
|-------------|---|----------|
| Cylinders | — | Six |
| Bore | — | 5 inches |
| Stroke | — | 7 inches |
| Rated Power | — | 200 |

Capacity as required

HALL-SCOTT MOTOR CAR CO.
Executive Office—Coucher Building
San Francisco California



Now— All Together!



NOTHING could stand against the
audacious dash of the French and
American cavalry on the Marne
—the German lines gave way, broke
back, the day was won.

That fighting spirit of the men of
Fush and Pershing that united purpose
—for Victory—must be the spirit, the
purpose, of each of us behind the gun.



We must lead as well as they fight
and we must join together with all the
strength we have—now!

We must so order our lives that
we can secure the best—and all
—to the last—our Victory. We can
put America's whole strength behind
our fighting men.

Now—All Together!

Let us lend the way they fight

Let us buy bonds to our utmost



L. W. F. ENGINEERING COMPANY, COLLEGE POINT, N. Y.



AIRCRAFT



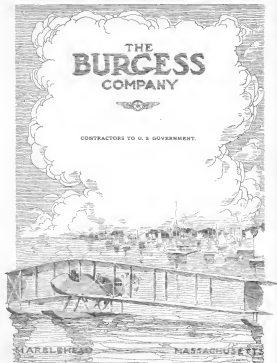
TRADE MARK

THE entire organization and skill, experience
and ability of this company are devoted to
intensive production in the interests of the
United States for the period of the war.

WHEN peace comes Martin commercial and
pleasure airplanes will maintain the
supremacy of performance and depend-
ability which they have held since 1909.

THE GLENN L. MARTIN COMPANY
CLEVELAND, OHIO

Contractors to the United States Government



**THE
BURGESS
COMPANY**

CONTRACTORS TO U. S. GOVERNMENT.

MARBLEHEAD MASSACHUSETTS



The Air Supremacy of the Future

HOW much America will need aircraft after the war is fully realized by the Wright-Martin Aircraft Corporation.

Although the present activities of the plant are directed to war work and the production in quantities of the famous Hispano-Suiza engine, plans are already made for the industrial needs of the future.

This Company owns many basic aeroplane patents; it has among its executives some of the best-known figures in aeronautics; and its history since its foundation is a history of steady development and unusual success.

**Wright-Martin
Aircraft Corporation**

New Brunswick, New Jersey
Long Island City, New York
U. S. A.



TEAM-WORK

Today every American has his position to fill and his work to do—with his duty clear

By J. MORACE LYTLER

NO force on earth can defeat a sublime, popular patriotism—if backed by perfect Team-Work.

Team-Work is, and ever has been, the keynote of all success.

Let us illustrate in terms of the game. A team must play together—one man for the other—every play for the good of the team, as a whole, not the glory of any one player. This is true whether it be in football or business, baseball or WAR.

And such team-work wins games. Just as it also wins battles—and WARS.

The War is the greatest game we are playing today. It is the business of the hour. It is our business to win. **WE ARE WINNING.**

And it is the Team-Work, as well as the spirit, of America and her Allies that is doing it. America has a great team in the field. On this team are the soldiers, sailors, statesmen, workers, doctors, nurses, bankers, merchants, manufacturers—all working for the good of the whole.

On our team, in the trenches, we have poor boys, rich boys, farmer boys, col-

ored boys—all fighting together side by side, advancing, falling, bleeding—dying side by side. It is the most perfect tribute the world has ever paid to the democratic principle. And it is the most superb Team-Work.

Those wonderful, those glorious boys in France are to our great war team what the back-field men are to a football team. They are carrying the ball. All praise to them—and let all the glory that can come be theirs!

But, let us in justice also remember, those lads in France could not go far if it were not for the part that others are playing behind the lines. Even though our work may not be so spectacular, let us do our duty. Doing our duty means—well, we all know what it means if we stop to think.

Right now it means **BUY BONDS** of the Fourth Liberty Loan.

Buy **MORE** Bonds! Before Oct. 1919!

And, by so doing, we will perfect the Team-Work behind the boys at the front with a strength that no force on earth can stop—and we will shorten the way for those lads in France on their march to Berlin.

This space contributed to the winning of the war by

THE DAYTON WRIGHT AIRPLANE COMPANY
DAYTON, OHIO

"The Birthplace of the Airplane"



Airships — Military Kites
and Spherical Balloons
Card Tires for Airplanes
Rubber Accessories for Airplanes

Everything in Rubber for the Airplane
Balloons of Any Size and Every Type

GOODYEAR
AKRON

92 *Lynite* Parts in Rolls-Royce Aviation Engine

The remarkable extent to which *Lynite* enters into the making of the airplane engine is shown by the record-breaking Rolls-Royce 12-cylinder engine now being produced in this country.

Ninety-two parts of this power-plant, which represents the work of some of the best engineering talent in Great Britain, are made of it.

These include such vital parts as crank-case castings and pistons, both of which require great strength.

By the use of *Lynite* instead of cast-iron, Rolls-Royce engineers have saved 532 pounds without sacrifice of a single desirable quality, and, due to the exceptional heat-conductivity of *Lynite*, have obtained notable thermal efficiency.

Airplanes fitted with Rolls-Royce engines hold world's records for speed, climbing, reliability, weight-carrying and passenger-carrying.

Rolls-Royce engines supplied the power for the history-making flight of a Hendley-Page airplane from London to Constantinople. This exploit not only established a reliability record but hung up a new mark for weight-carrying. The total weight transported was six tons.

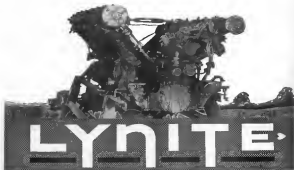
In making a world's record for passenger-carrying, Rolls-Royce power took 22 persons up 7,000 feet.

THE ALUMINUM CASTINGS COMPANY
679975 and 679976 Castings
Right Plane in
Cleveland, Detroit, Buffalo, Muskegon, Wis., Fairfield, Conn.



These *Lynite* Parts Used by Rolls-Royce

| | |
|-----------------------------|-------------------------------|
| Piston (14) | Control Bracket (2) |
| Crank Case (3 pieces) | Front End Control Bracket (1) |
| Wheel Case | Control Coupler Bracket |
| Injection Cover (2 pieces) | Magneto Bracket—A Unit |
| Gear Box Housing | Magneto Bracket—B Unit |
| Gear Box | Oil Pump Casing (4 pieces) |
| Cable Guide Bracket (2) | Oil Filter Box |
| Cable Guide Bracket Cap (3) | Cowling (3 pieces) |
| Piston Wristlets | Supercharger Bracket (4) |
| Patrol Wristlets Cover | Supercharger Bracket Cap (1) |
| Water Outlet Junction (2) | Water Pump Bracket |
| Air Pumps Crank Case | Tachometer Gear Casing |
| Cover (3 pieces) | Water Outlet (12) |
| Idle Shaft End Cover | Oil Relief Valve Casing |
| Oil Pump Bracket (2) | Water Pump T Connection |
| Oil Pump Bracket Cap (2) | Crank Case Breather |
| Gear Case T. H. (2 pieces) | Crank Case Breather Cap |
| Gear Case B. H. (2 pieces) | Down Cook Handle (2) |
| Clutch Shaft Housing | Injection Pipe—R. H. |
| (3 pieces) | (2 pieces) |
| Shaft for Housing (4) | Injection Pipe—L. H. |
| Wheel Case Cover | (2 pieces) |
| Rear Steady Bracket | |



STRAIGHT FROM THE TRENCHES

If you want to keep us
feeling this way—



Buy
Bonds!

Fourth Liberty Loan

One of a series of advertisements specially originated and produced for the Liberty Loan Committee entirely by members of the American Expeditionary Force

UNION GAS ENGINE CO.
OAKLAND, CAL.



Protecting the Air Fleet 34 Ways

Success in fight or flight may depend directly on the varnish used. When wings are pumiced the "dope" and Varnish must hold fabric against stretch or spread.

Airplanes to win must endure all extremes of temperature and climate.

When a varnish is put on an airplane it must be able to endure the noonday's sun in the Mesopotamian Desert and Arctic nights on the Murman coast equally well and without the slightest impairment.

The U. S. Varnish requirements for airplanes are so exacting that only the best varnish can expect to meet them. Thirty-four tests must be met. These requirements include every test to which a varnish may be put in war, home or industry.

Air-Plane Respar Varnish has met these thirty-four tests and received a first order for 50,000 gallons.

Every gallon of Air-Plane Respar Varnish is equal in quality to every other gallon.

Air-Plane Respar will merit your approval just as at merited the approval of the United States Government.

We can make immediate delivery of Air-Plane Respar Varnish in any possible quantity that you may require.

The Sherwin-Williams Company

806 Canal Road, Cleveland, Ohio

Branch Office and Warehouse in all important cities

The varnish on airplanes shall

1. Be smooth.
2. Be hard.
3. Be tough.
4. Be elastic.
5. Be strong.
6. Be tough.
7. Be tough.
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32. Be tough.
33. Be tough.
34. Be tough.

Sherwin-Williams Air-Plane Respar meets all these requirements





Come On!

buy more
LIBERTY BONDS

BAKER CASTOR OIL COMPANY
120 Broadway New York City



Radiation
not just
Radiators

The cellular type of radiators has been adopted by the U. S. Government as the standard type for aeroplane work.

The MAYO Radiator is best suited for aeroplane use because of its light weight and because, by reason of its greater efficiency, it requires less frontal area.

MAYO  **Radiators**

MAYO RADIATOR DIVISION OF MAYHEW ROSS & FELL Corporation, 1124 Street and Madison Avenue, NEW YORK CITY



Red Bull, N.Y. 1918

THEY GOT THERE IN TIME

They are in the fight with every muscle every faculty of their minds, every drop of their American blood

You have read in the daily news the story of what one detachment of American artillerymen did on the Marne when their ammunition was running low. Every shell in that caisson meant a speedier winning of the war—all the horses were killed—but the shells got there just the same. And they got there in time.

Where shall we draw the limit when we read what they are doing over there? Now is the time to put our full strength into it. Our strength, coupled with the power of our Allies, will win. Let us not delay even a few months. Let us get there *in time* to *hasten the victory—to save the lives of our sons.*

How can any one of us back here at home, set any limit to the help we ought to give—for victory? And we must get it there *in time!*

This Space Contributed to Financing the War by

THOMAS-MORSE AIRCRAFT CORPORATION, ITHACA, N. Y.

The Supremacy of
FEDDERS
RADIATORS

FEDDERS MFG. CO. Inc.
BUFFALO, N.Y.

STRAIGHT FROM THE TRENCHES

Pvt. Treptow's Pledge



Private Treptow was a battleship veteran. The day last week that the Yanks greeted the Burgs, he had almost reached his goal when a machine gun silenced him.

In a pocket of his blouse, they found but 1 dime. On its face was his picture, something that every man had once owned. It said that America shall win the war.

Wherefore I will work, I will save, I will sacrifice, I will endure, I will fight cheerfully and do my utmost, as if the whole issue of the struggle depended on me alone. Treptow had called this his pledge, and there to he had subscribed his name.

Private Treptow has given his life that America shall win the war.

You who are not called upon to die—
Subscribe to

the Fourth Liberty Loan

Contributed to the Winning of the War by

RADIUM DIAL COMPANY
GENERAL OFFICES—PITTSBURGH, PA.

104 FIFTH AVE., NEW YORK—MARSHALL-FIELD ANNEX BLDG., CHICAGO—LEWIS BLDG., BOSTON
DIAL PAINTING FACTORIES, PITTSBURGH, LONG ISLAND CITY, N. Y., CHICAGO



Whose Fight?

THREE MILLION MEN—half of them in France—many more in training

But is this all their fight?

It takes ten men at work to keep one fighting man at the front.

It takes millions of dollars just to keep the army fed. It costs thousands of dollars every time one battery of big guns lays down a barrage.

Is it any wonder then, that the United States is spending at the rate of fifty millions of dollars a day in war and war plans? And with that grand total as the estimate on a far vaster principal, which must support the colossal cost of all this task will have been in vain, whose fight do you think this is?

The man's in the trench? The fellow's on the supply-trail? The chap's on the gasper's deck?

No, it is yours!

It is your fight, Mr. Stocker—yours, Mr. Manufacturer—yours, Mr. Merchant—yours, Mr. Mechanic—yours, Mr. Worker—yours, Mr. Farmer. This fight is yours, all of you who

are left behind, as much or even more than it is the man's in the trench.

For that man, though three million strong, cannot raise a hand in the cause of democracy, he cannot even raise a hand in self-defense, except for you.

He is potent only as you are potent. He can fight only as you will fight. The difference is only this: His fight is expensed in nerve and ammunition, yours in work and dollars.

The Fourth Liberty Loan is the world's biggest drive back of the lines. It is the test of the financial reserves of the entire country of ours. It will gauge the power that you intend to put back of the fighting men in France for the next half year or more to come.

In fact it will show the value you place on the heritage of liberty, which these million men have taken up arms to defend for you to-day.

Take care when you sign that subscription blank for Liberty Bonds that the amount you set aside is nearly as it can with all your heart acknowledge this heritage to be worth to you.

Buy United States Government Bonds
OF THE FOURTH LIBERTY LOAN

The Space Contributed to Winning the War by

R. F. STURTEVANT COMPANY
STURTEVANT AEROPLANE COMPANY
BOSTON, MASSACHUSETTS



Dollars that Fight

By SENATOR HENRY CABOT LODGE

The war will be won by men and ships, by guns and airplanes. To raise armies and supply them to build the navy and support it and to furnish ships and transport, we must have money in large amounts. The expenditures of the Government for the ensuing year are estimated at \$2,000,000,000, a sum which baffles the imagination to conceive. That vast amount must come

as first from taxes and two thirds from loans. The success of the Fourth Loan like those that preceded it is, therefore, absolutely necessary. We must work with the highest speed, as if the war was to end in six months. We must prepare in every direction, as if it was to last for years. Speed and preparation are both expensive.

Without the Loans We Cannot Have Either

We are fighting to secure a just, righteous and lasting peace. For a complete peace we must have a complete victory. It must not be a peace of truce or of temporary truce. No peace which satisfies Germany can last. We must win. We must win Germany in a position to remove the war against us with her sword. It will be the fact of the matter to give all our citizens on the Western front—Belgium, Alsace-Lorraine, Italy, Sweden. The President with wisdom and insight and great force expressed his determination to defeat Russia. Russia must not be left in Germany's hands.

We Cannot Win Without Money, and, Therefore, These Loans Are Vital, and the Country Should Rally in All Its Strength and Subscribe and Oversubscribe the Fourth Loan

Buy Bonds to Your Utmost!

The Space Contributed to Placing the War by
SPERRY GYROSCOPE COMPANY, BROOKLYN, NEW YORK



To Speed up Repairs

Here's something absolutely new—used as pointed, efficient and successful as it is designed.

The Beach Automatic Grip Puller (Junior Size) is designed to remove all gears—on all airplanes, motor-cars, trucks and ships. It is the only automatic grip puller on the market and is ideally adapted for shortening contracting and repair-work time.

It simply turns the hardened and steel screw at the top, the drive lever and automatically grip work and hold. Removal of the spring, magnetic and pump shaft gears and couplings is then only a matter of seconds.

And it's light, too, weighing but 25 lbs. with the extra set of arms furnished with each lot.

Remember the BEACH AUTOMATIC GRIP PULLER (Junior Size) is adapted to any type of airplane motor, by simply changing the arms to fit the gears which are to be pulled.

The BEACH is the ideal repair-shop and factory tool—cheap-made and in use now all over the country. Just the puller for the tool kit. It does away with the necessity of building a special puller for each set of gears.

It is a combination of two or three gears.

Write for our illustrated list of which gives full details of this great little time saver.

We also manufacture a large size BEACH AUTOMATIC GRIP PULLER—capacity 1" to 18"—for heavy duty work.

CONTRACTORS TO THE UNITED STATES GOVERNMENT

The Grib Company

MANUFACTURERS OF AUTOMOTIVE AND GARAGE EQUIPMENT
190 State Street, - - Boston





"ACES" UP!

We are proud of the part that Dural products are playing in helping the American aces to win success in the air.

Rubber Parts for Aircraft

are our specialty. We were among the first in the field and as a result of our experience and knowledge, we have built up a quantity production with all its advantages of quick deliveries—yet every part is

MADE AND INSPECTED AS IF IT WERE THE ONLY ONE

Our chemical laboratory and staff of experts are at your disposal to work out new ideas.

It is possible that in our experimental work we have covered the very ground you are traveling towards something new and better in rubber parts for aircraft. It will save you much time and money if you allow us to show you the trail we have blazed, marked and logged.

Write us

DURAL RUBBER CORPORATION
FLEMINGTON NEW JERSEY

"DURAL-Above All"



"NORMA" PRECISION BALL BEARINGS

(PATENTED)

Precision must rest on performance. Claims are futile things, in these times when service is sought from all and placed before all. And nothing but the staunchest serviceability can maintain that character of performance which stands for full service faithfully rendered.

"NORMA" Precision Bearings—the standard bearings in high-grade ignition and radio electric apparatus—have to their credit years of performance records under such speed conditions as to establish their preeminence beyond question.

BE SURE—See that your Electrical Apparatus is "NORMA" Equipped

THE NORMA COMPANY OF AMERICA

1770 BROADWAY NEW YORK

Ball, Roller, Thrust and Combination Bearings



OCTOBER 15, 1918

AVIATION AND AERONAUTICAL ENGINEERING

VOL. V. NO. 6

Member of the Audit Bureau of Circulations

INDEX TO CONTENTS

| | PAGE | | PAGE |
|--|------|---|------|
| The 300 H.P. Maybach Engine | 387 | Some Heavy Airplanes | 395 |
| The Seventh-Circuit "Circuit" | 394 | British Advisory Committee Report for 1917-18 | 398 |
| Aeronautical Electric | 396 | New Daimler-Benz Engine Test House | 371 |
| Production Problems of Aircraft Belts, Screws and Nuts | 395 | Digest of the Foreign Aeronautical Press | 372 |
| | | News of the Forefront | 375 |

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A Soldier Facing Death For You

Somewhere in France today, at this very minute, there is a soldier looking straight into the face of death.

He is doing this for you

By night and day, in storms, in rain, in cold and gloom, doing a hundred deaths he never hesitates a moment but does his duty without a thought of himself and without a thought of reward.

What are you doing for him today?

When you think of that man don't you want to do something to prove that you appreciate what he is doing for you?

Of course you do. Then act on your desire and buy Liberty Bonds which will help to safeguard him and to bring him back home.

After you have bought all you can tell your friends to do the same.

**BUY LIBERTY BONDS TODAY
ANY BANK WILL HELP YOU**

THIS SPACE CONTRIBUTED BY SERVING THE WAR BY
WYMAN-GORDON COMPANY, WORCESTER, MASS.

Quality



Mill Assembling



Testing Samples for Chemical Analysis

Inspecting New Maybach Engines and Various Products

NEW

DEPARTURE quality is guarded months before the first part is cut.

Special chrome alloy steels are made to the specifications of our engineers and personally overseen by our experts.

Upon receipt at the factory, the steel is examined, analyzed, checked—and accepted only when it agrees with our formulae.

When we know we have the best steel it is possible to produce—when only it is ready to be made into

**New Departure
Ball Bearings**

THE NEW DEPARTURE MFG. COMPANY,
Brock, Conn. U.S. Patent Pending



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VOL. V

October 15, 1935

No. 4

The 300 Horsepower Maybach Engine*

During the past few months several of the latest type of Maybach engines have been reported fitted with the new 300 hp Maybach engines. The general layout of this engine takes the usual German vertical, water-cooled type. The compression ratio is exceptionally high, viz., 20.4:1, which

and have been only slightly modified, as shown in Figs. 1 and 2 they are arranged, as in the Zeppelin engines, in the front and rear cylinder water jackets.

The well-known Maybach induction type starting gear is fitted, but is slightly modified in design.



FIG. 1. EXTERIOR, FRONT SIDE OF ENGINE

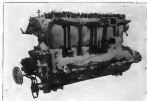


FIG. 2. REAR - REAR SIDE OF ENGINE

mounts the oil—oil very heavy pistons and connecting rods. In this particular, this engine follows the previous Maybach engines, but the cylinders of a cast steel casting back to the left and bearing is an interesting design.

Four overhead valves per cylinder are fitted—two on each side and two on each side. These are operated by rockers levers mounted on roller bearings in brackets to the cylinder heads and by push-rods in each side on the cylinder mounted in separate side and exhaust manifolds. The mechanical valve in place of the lever type in the crank-case and are replaced by a lever.

The three separate and distinct gear sets of the engine, which are arranged on the bottom of the base chamber, are of two designs. The pump driving shaft at the front and is driven through a chain drive on the front camshaft gear, together with the three separate gears, together with the three of providing an air lock in the lubrication system in the event of back-flow.

A double set of oil-cooled pistons is fitted at the rear (Fig. 3). This is driven off an extension of the crank and pump shaft at the rear end of the base chamber, and works, of course in conjunction with the two separate pistons. These are of the well-known Maybach type.

*Courtesy of a paper issued by the Technical Department of the Reich Air Ministry.

The whole of the induction system and oil cooling system, and the ventilation system is an interesting point in the design of this engine, as is also the method of attaching the propellers during flight on the tapered front end of the crankshaft.

Attention is to the front high pressure injection, which are driven off the rear end of the crankshaft.

Cylinders—In comparison with the Zeppelin Maybach engines, the cylinder of the new 300 hp Maybach engines are of very much lighter construction; and, as well as are seen from Fig. 3, are of a wonderfully close design.

Each cylinder is built up of a thin barrel, mounted and ground to 165 mm. bore, and mounted on its end on a cast iron of a diameter of 3 mm. The thickness is increased from 2 mm. at the bottom of the water jacket to 4.5 mm. at the cylinder base flange. The top of the cylinder barrel is secured the cylinder head, which is of cast-iron. A detailed sketch of this arrangement is shown in Fig. 4. The cover thread is 2.5 mm. pitch (metric thread) and will have a hole in the top of the cylinder head. The hole is drilled at this point between the cylinder head and the top face of the second portion of the cylinder barrel.

The bottom of the cylinder barrel is machined with 2.5 mm. hole in the base flange into the reversing part of the crankshaft, and the bore of the cylinder is very little changed.



FIG. 3. A PISTON, CONNECTING

The design of the cylinder heads and the formation of the water passages and exhaust valves is unusual, and the double inlet and outlet water connections in lower each pair of cylinders are of new design. The formation of these inlet water connections is shown in Fig. 2, together with the water passages and around the sparking plug bosses, the latter are situated in assembly situated in the space between the two cylinder head water ports. The two semi-circular bosses which are cast on the sides of the cylinder water ports are provided for the attachment of the two pistons, which are fixed to the front and rear cylinders by long studs.

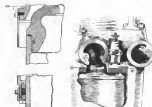


FIG. 4. DETAIL OF CYLINDER HEAD AND WATER PASSAGE. FIG. 5. SECTION OF CYLINDER HEAD, SHOWING WATER PASSAGES AND CONNECTIONS.

separated from these bosses in the water ports. To allow for the interchangeability of the cylinders these bosses are drilled in every cylinder, when the cylinder is not assembled at the front or rear they are played with loose guide screws, as shown in the sketch.

An interesting point of design in these cylinders lies in the fact that no water connections between the cylinders are made other than the two head ports referred to.

The exhaust valve ports are provided with an additional water passage above the exhaust port, and serve as an inlet for a few water pipes completely round the outer portion of each exhaust valve stem guide (Fig. 6).

The valve guides cast in the cylinder heads are fitted with end-on bushes ground in position. The exhaust bushes do not extend the full length of the guides as the inlet do, but are kept back a distance of 16 mm. from the bottom of the guide, so that they are protected from the hot gases. As a further precaution against scoring, the diameter of the bottom of the exhaust bush is slightly reduced, so that the bush has room to expand.

Contrary to the usual German practice of building up the water jackets of sheet metal sections welded at the joints, the water jackets are machined from cylindrical steel forgings, which, as shown in Fig. 4, are milled on to the flange and shaped on the cylinder head, the pitch of this thread is 1 mm. This recessed flange is flange seated in position with such a wide depth of the recessed portion bearing against the head previously formed, the joint is locked with four 8 mm. grub screws.

The whole of the water jacket is machined back on the inside and also on the outside surface to a thickness of 3 mm. The water jackets extend to 144 mm. from the base of the cylinder, or, in other words, to two-thirds of the total length of the cylinder barrels, and, as will be noted, the water space is completely narrow—i.e., 7 mm.

The only water passages from the cylinder head to the air water space of the water jackets is through the opening or passages cast in the cylinder heads covering the sparking

plug bosses and situated directly below the two water connections of these two water passages (Fig. 5). The water jacket capacity of one cylinder = 1264 c.c.

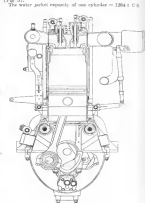


FIG. 6. CROSS-SECTION.

Fig. 4 shows an enlarged view of the lower part between the cylinder head and the water jacket. This part consists of a soft rubber composition packing ring, compressed in position between two steel rings by a large ring which serves as a tie at the bottom of the water jacket in a fine pitch drilled in the lower part of the sketch. This joint is, in a certain extent, tight and allows for the relative expansion between the cylinder head and the water jacket.

Small disc plugs are provided at the bottom of each cylinder water jacket, these are secured into holes milled inside the water jackets on the exhaust side. The construction resembles a screw, but it is slightly recessed below all of the four ribs into, which are all of the same diameter—i.e., 64 mm. The area of both the inlet and exhaust ports is 38.15 sq. cm. = 4.86 sq. in.

The clearance volume of one cylinder = 7748 cc. or = 474 cu. in., giving a compression ratio of 3.64:1. Short pieces of aluminum tube are fitted over the top of the legs in the cylinder heads forming the valve seat guides. These are apparently provided for lubrication purposes. This short short pieces are fitted to the inlet and also to the ports of the cylinder heads to stiffen up the engine.

Pistons.—The pistons are of cast-iron, and weigh 123 lb. each, complete with rings. Four rings are fitted all over the pistons pin, the lower one being a scraper ring at the top and the other three are 6.5 mm. wide (scraper) and 5.5 mm. deep, the depth of the ring groove being 6 mm. The pistons, as will be seen in Fig. 5, are fixed on both top and bottom surfaces of the crown, which is 105 mm. in

sketch. Eight 4 mm. return of holes are drilled through the pistons below the scraper ring in the usual way.

The rings are cut diagonally at 45 deg., no loading pins being fitted, and the width of the ring gap in the cylinder is 1.38 mm. = 0.05 in.

All the piston rings are machined in their rear surface. This process, which is now extensively used, and will lower, consists of supporting the inside face of the ring by means of mechanical lances above at gradually increasing



FIG. 7. DETAILS OF PISTONS, SHOWING PIN AND CONNECTING ROD.

distances apart. The process shows a large number of small narrow depressions extending across the width of the ring on the inner surface. These depressions caused by the lances are approximately 3 mm. apart at the back portion of the ring, i.e., the part of the ring farthest from the gap, and narrow in a mathematical progression to about 4 mm. apart towards the front of the ring up to about one inch, an oil ring on the side of the gap. This mechanical hammering of the inside ring has the effect of giving the desired uniform pressure to the scraper ring against the cylinder wall.

The holes for the pistons pin are bored concentrically to the

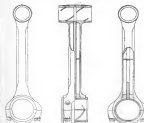


FIG. 8. DETAIL OF CONNECTING ROD.

pistons pin bosses, giving a clearance of 0.01 in. to 0.015 in. and 0.01 in. below the pistons pin. An oil groove is cut in the piston skirt below the pistons pin, and is used to keep the scraper ring and the pistons lubricated. The inside of the skirt is machined up as far as the bottom of the pistons pin bosses, and a beveled lip is turned on the bottom edge of the skirt. The inside of the piston is also machined to form the head and down as far as the top of the pistons

pin bosses with a 15 mm. radius, an oil groove is cut in the inside of the skirt to lubricate the pistons pin bosses. The pistons pin bosses are 150 mm. long, slightly tapered at the end, and are fixed in position in the piston by a single chrome-plated 9 mm. nut screw in the axial way and locked with a split pin.

The pistons pin bosses are hardened and ground to three parallel outer diameters, being made of smaller diameter at one end than the other. The outer portion which makes the small end bearing is 35 mm. diameter, and the two ends which fit into the pistons pin bosses are 27.5 and 28.25 mm. diameter respectively.

The pistons pin bosses are bored 35 mm. diameter in the center tapering to 28 mm. at each end. Flaring small end bosses are now fitted to the pistons pin in the connecting rod smaller ends. These flaring bosses



FIG. 9. VARIOUS VALVE AND VALVE GEAR PARTS.

pin made of cast-iron of a very soft nature. The effective bearing length of the flaring bosses is 95 mm., and their external diameter is 44.3 mm. For lubrication purposes a number of 4 mm. holes are drilled and milled on the inside.

The projected area of the small end bearing surface on the pistons pin is 54.3 sq. cm., and the bearing surface in the center of the rod end is 48.5 sq. cm.

The weight of each pistons pin is 155 lb., while the entire flaring bosses weigh 0.62 lb. each.

Connecting Rod.—Following the usual Maybach design, the connecting rods are of square section beveled at the four corners, and bored up the center from the big end with a 28 mm. diameter hole, which is secured and plugged as shown in Fig. 8.

The big end bearing pin is secured by four 14 mm. bolts, which are secured 1.5 mm. pin into the top half of the connecting rod big end.



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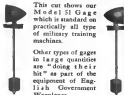


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THE HESS-BRIGHT MANUFACTURING COMPANY

Where Performance takes Preference over Price



Thoroughly Well "Bearinged"

The allied airplanes that are making records on battlefronts today are equipped with power organisms and electrical devices so thoroughly well "bearinged" that friction is reduced to a minimum and wear almost eliminated.

Airplanes of necessity operate at high speed and under severe conditions. And then, too, the possibilities of bearing troubles multiply with the speed.



Engineers are aware of the fact that unless the bearings are correctly designed and accurately manufactured from the best steel procurable, bearing troubles are sure to develop.

Airplanes equipped with ball bearings marked SKF have the factor of safety built into them which permits efficient operation even under the most difficult conditions. Ask the leading airplane manufacturers what they think about SKF Ball Bearings.

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